

## NUT-LIKE IMPRESSIONS ATTRIBUTED TO AQUATIC DICOTYLEDONS FROM VICTORIAN MESOZOIC SEDIMENTS

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### Abstract

Nut-like impressions comparable with the dicotyledonous genus *Hemitrapa* Miki, hitherto unrecorded from pre-Tertiary deposits, are described from 3 localities in Victorian Mesozoic sediments and their stratigraphical and ecological implications discussed.

### Introduction

Fructifications and seeds were recorded in the earliest collections of Victorian Mesozoic plants, but have been only perfunctorily described as academically interesting but stratigraphically valueless fossils. The impressions of nut-like organisms described below are from 3 widely separated localities (Fig. 1) and afford a means of comparison of the beds concerned.

### Description of Types

#### ANGIOSPERMOPHYTA

##### DICOTYLEDONEAE

##### *Hemitrapa?* sp.

(Pl. III, fig. 2-5; Pl. IV, fig. 3, 4)

**OCCURRENCE:** South Gippsland—Gemmill's Hill, Madalya Road, Co-ords Mirboo North Military Sheet 4446E, 2562N. Koonwarra road cuttings South Gippsland Highway, Co-ords Wonthaggi Military Sheet 3966E, 2457N.

**SPECIMENS IDENTIFIED:** Geological Survey of Victoria Reg. No. 58230, 58232, 58229, 58228 (counterpart), 58226, 58646 (counterpart), 58569, 58570 (counterpart), 58649?, 58238?, 58568? (counterpart), all Gemmill's Hill. Some 30 specimens have been recognized. Collected March 1959. 58644, Koonwarra, single specimen only, collected February 1962.

**ROCK TYPE:** Gemmill's Hill specimens—very soft, fine-grained buff yellow siltstone with plant impressions.

Koonwarra specimen—yellow-brown laminated mudstone with plant and animal remains.

**DESCRIPTION:** Small spindle-shaped nut-like body with portion interpreted as receptacle elongated into 2 long, sometimes recurved, unbranched appendages, often more than twice the length of the body. Sheathing tissues or coarse hairs at the top of the nut form a conical capping, and the base lacks a peduncle.

**DIMENSIONS:** Length of nut—maximum 3 mm. Length of appendages—maximum 7 mm.



Fig. 1—Locality map showing occurrences of nut-like fruits in Mesozoic sediments, Victoria, Australia.

DISCUSSION: A group of fossil remains previously classified under *Trapa* Linnaeus, a genus with present day representatives, was separated by Miki (1952) into *Hemitrapa* Miki 1941, a genus described from fruits in the form of spindle-shaped and appendaged nuts. *Hemitrapa* was grouped with *Trapella* Oliver in a new family Trapellaceae and the South Gippsland remains compare best with fossils from this group. No described species of *Hemitrapa* corresponds with the Victorian forms, although the widespread *H. borealis* (Heer) Miki, which may be up to 8 times larger, appears to be distinguished on size alone. Features such as appendage form, length and number enable ready distinction between species, but other less obvious features such as the proportion of fruit sheathed by receptacle tissue, and the presence or absence of apical hairs or sheathing tissue require some interpretation.

Preservation as impressions ensures that important details of internal anatomy cannot be resolved, and interpretation of structure must be based on external morphology.

The appendages in these South Gippsland specimens are interpreted as extensions of receptacle tissues as in *Hemitrapa*, and the sheathing tissue or coarse hairs around the top of the nut are similar to the hairs described by Miki (1952).

The evidence for classification within the genus *Hemitrapa* is summarized in Table 1, where prominent characteristics of comparable *Trapa* and *Hemitrapa* species are listed for comparison with the Victorian specimens. Some difficulty in classification is presented by the lack of anatomical evidence for nut fruit character. However, the specimens correspond so closely to *H. borealis* (except for size difference) that tentative determination within the genus as interpreted by Miki (1952) appears warranted. This size difference, however, is regarded as sufficient to preclude determination on a 'Cf.' *H. borealis* basis. New specific nomenclature is not advocated because of the relatively poor preservation, and the inadvisability of specific distinction on size alone.

The vegetation bearing these fructifications is unknown, and no angiosperm leaves have been described from the eastern Victorian Mesozoic. Associated at

Gemmill's Hill are a number of seed impressions and a very few leaves, including *Phyllopteroides dentata* Medwell. Although the affiliations of these remains are unknown, they are generally classified with groups more primitive than the angiosperms, and are not likely to have shed the fructifications.

Three tentatively identified specimens are listed. These consist of small branched stems and attached organs, but their relationship to *Hemitrapa* ? sp. is not yet established.

Cf. *Hemitrapa* sp.

(Pl. III, fig. 1, 6, 7; Pl. IV, fig. 1, 2)

**OCCURRENCE:** Western Victoria—Koroit (Yangery No. 1 bore 4320-4330 ft).

**SPECIMENS IDENTIFIED:** Geological Survey of Victoria Reg. No. 57807, 58654, 58655, 58656, 58657, and 58658 (counterparts), 58569, 58660, 58661. Some 170 specimens have been recognized. Isolated by author from core received September 1960.

**ROCK TYPE:** Hard, blue-grey siltstone with plant impressions.

**DESCRIPTION:** Small nut-like body with portion interpreted as receptacle apparently elongated into 2 straight or slightly recurved, unbranched appendages, sometimes twice body length. The appendages diverge from shoulders at the apical region which may possess a small crown or protruberance. The base lacks a peduncle.

**DIMENSIONS:** Length of nut—1-2 mm. Length of appendages—maximum 5 mm.

**DISCUSSION:** These remains differ in form to some extent from the eastern Victorian *Hemitrapa*? fruits and are generally a little smaller. Preservation is finer, and in the form of black carbonaceous impressions, with nut-like form more strongly indicated (Pl. IV, fig. 1, 2), but interpretation of structure is difficult because of the grain and flaky nature of the carbonaceous material. Treatment with Schulze's oxidizing reagent on a hot plate resulted in the isolation of some acid insoluble tissues, but this, derived from the external portion of the nut, was of no assistance in the elucidation of internal anatomy.

The remains are again interpreted as a bi-appendaged nut with the appendages derived from receptacle extensions. However, they arise from near the top of the nut, which generally possesses a small projecting protruberance or crown (Pl. III, fig. 6; Pl. IV, fig. 1). The apex of the nut does not form a conical capping above the shoulder of the appendages as in the South Gippsland forms.

The broad spindle shaped nut-like body bearing long appendages, affinity with the *Hemitrapa*-*Trapa* group, and apical protruberance reminiscent of stylar remnant are best evidence for a fructification nature. Some present day reproductive organs e.g. (Rosaceae, Chenopodiaceae) show similarity in size, but the pre-Upper Tertiary record of these is dubious, and they differ from the fossil types in body and appendage form. The features in common with the Gippsland specimens determined as *Hemitrapa*?, in addition to the absence of an apical sheath or hairs, again render a tentative classification advisable. Comparative nomenclature with reference to *T. silesiaca* Goeppert (Table 1) is not warranted because of the greater size and comparatively shorter appendages of this latter species, and the possibility that this and other smaller specimens attributed to *Trapa* (e.g. *T. credneri* Scheuk) bear no real relationship to the present day genus.

Institution of a new form genus at this juncture is regarded as unnecessary and contributory to the overspeciation already existing in palaeobotanical nomenclature.

Affiliation with aquatic vegetation is substantiated by the presence in the same



core (Yangery No. 1 bore, 4320-4330 ft) of leaves of *Hydrocotylophyllum lusitanicum* Teixeira (Douglas 1963). This species, possibly affiliated with the present day *Hydrocotyle asiatica* Linnaeus, has similar leaf form to certain *Trapella* species, e.g. *T. sinensis* Oliver, but is not likely to be the source of the nuts as it is separated by 6 inches of sediment. *Phyllopteroides dentata* leaves are also associated in this core, but do not occur in the bedding planes of the aquatic fruit or leaf remains.

TABLE 1

*Some characteristics of Victorian nut-like fruit remains compared with overseas forms.*

Fruit description	Gemmill's Hill specimens	Yangery specimens	Koonwarra specimen	<i>Trapa silesiaca</i> Goeppert	<i>Hemitrapa borealis</i> (Heer) Miki	<i>Hydrocotylophyllum lusitanicum</i> Teixeira
Length of body	Maximum 3 mm	Maximum 2 mm	1.6 mm	Much longer than Vict. forms	Much longer than Vict. forms	Fruit unknown, but on affiliation with <i>Hydrocotyle asiatica</i> , possibly schizocarp in two mericarp form
Nut shape	Spindle	Expanded spindle	Spindle	Expanded spindle	Spindle	
Peduncle	Absent	Absent	Absent	Apparently present	Sometimes present	
Form of apex	Hairs in conical arrangement	Small crown? Stylar remnant?	Hairs in conical arrangement	Small crown?	Hairs in conical arrangement	
Appendages: Number	2	2	2	2	2	
Form	Elongated strongly recurved non-bristled	Elongated somewhat recurved—straight apparently non-bristled	Somewhat recurved—straight non-bristled	Short, straight sometimes bristled	Short, somewhat recurved non-bristled	
Length from point of divergence from body	Max. 7 mm	Max. 5 mm	2 mm	Not longer than nut length	Generally not longer than nut length	
Derivation	Interpreted as extension of receptacle	Interpreted as extension of receptacle	Interpreted as extension of receptacle	Extension of receptacle	Extension of receptacle	

#### General Remarks

Although generic relationship has not been positively established the close relationship between the two forms discussed is a striking feature of the deposits. This is the first record of fruits referable to the angiosperms in pre-Tertiary deposits in Victoria, and along with *Hydrocotylophyllum* indicates the presence of an extensive angiosperm element in the floras of the time. This angiosperm element (from the 3 localities discussed) is regarded as aquatic because of comparison with the aquatics *Hemitrapa* and *Trapa*, the co-fossilization with leaves determined as

*Hydrocotylophyllum*, and peculiarities of deposition including fossilization 'en masse' (see below) and preservation apart from other members of the extensive Victorian Mesozoic flora.

In the two principal deposits (Yangery and Gemmill's Hill) the profuseness of the nuts in close proximity indicates that fossilization took place either at the locality of growth (most present day *Trapa* species shed nuts which sink immediately beneath the plant (Miki 1959)), or that the fruits were liberated from a nearby plant after transport. In both cases the parent plant should be in close proximity. At Yangery the co-fossilized *Hydrocotylophyllum* is a possible parent plant, but the actual specimen isolated was unlikely to have shed the fruits for the reason detailed above. Also this genus, if truly related to *Hydrocotyle*, would be expected to bear dry schizocarps in two mericarp form.

The *Hydrocotylophyllum*-Cf. *Hemitrapa-Phyllopteroides dentata* assemblage provides an extension of this theory with the possibility that all these remains are organs from one species. The present day genus *Trapella* (classified with *Hemitrapa* in Trapellaceae, or Pedaliaceae (Oliver 1888) has a vegetative body with floating leaves similar to *Hydrocotylophyllum*, and subaqueous leaves of form similar to *P. dentata*. However, apart from the considerations discussed above, the venation of *P. dentata* indicates that it belongs to a non-dicotyledonous group.

Palynological studies in both localities have not resulted in the isolation of pertinent microfossils. Any number of theories could explain this, but evidence provided by the presence of mature? fruits indicates that the pollen production period had ended, with previously shed material removed earlier by the dispersal agencies characteristic of the aquatic environment. The absence of dicotyledonous pollens from Victorian deposits of a similar age (see 'Age of Sediments' below) has been commented upon by Cookson (pers. comm.). Apart from the fact that the Gemmill's Hill and Yangery remains are in upper beds of the non-marine Mesozoic formation which have not been extensively palynologically sampled, the absence may be explained by pollen dispersal peculiarities inherent in a possible aquatic flora.

The lone *Hemitrapa*? specimen recorded from Koonwarra could be regarded as an erratic carried from afar, although there is no evidence for or against this theory. However, discussion of the nature of this assemblage and accompanying very finely preserved fish remains is idle, as very little is yet known of either.

### Age of Sediments

The fruits, at best determined only tentatively to generic status, give little aid to precise geological dating of the sediments, but they do indicate that these are not pre-Cretaceous. The fossil record of *Hemitrapa* and *Trapa*-like fruits is almost entirely restricted to the Tertiary, but these Victorian remains are found in sediments well established on macro- and micro-plant remains as Mesozoic.

Dettmann (1959) and Cookson and Dettmann (1958) regard the bulk of this Mesozoic as Lower Cretaceous, although admitting the possibility of the lowest members of the sequence to be 'uppermost Jurassic'. No Victorian non-marine Mesozoic beds have been dated as younger than Lower Cretaceous. Douglas (1963) dates the Yangery *Hydrocotylophyllum* and Cf. *Hemitrapa* bed as Lower Cretaceous, and as the Gemmill's Hill beds are at the top of an extremely thick Mesozoic sequence with a floral assemblage indicating some contemporaneity with the former, I regard these also as Lower Cretaceous. Elucidation of the ecological relationships and dating of the Koonwarra beds will be facilitated when a study of the fossil fauna and flora has been completed but at the present, on the basis of the

palynological work of Cookson and Dettmann, these also are regarded as Lower Cretaceous.

### Conclusions

Although also probably representing an environmental or facies relationship, the floras of Gemmill's Hill and Yangery are sufficiently similar to postulate contemporaneous deposition.

The dicotyledonous floral assemblage attributed to an aquatic environment may thus represent a stratigraphically valuable marker in the as yet undifferentiated mass of the Victorian non-marine Mesozoic.

NOTE: Subsequent to the preparation of the manuscript numerous other specimens of the form determined as *Hemitrapa*? sp. have been isolated by Miss Elizabeth Carroll, research student, from the Melbourne University Geology Department collection of Koonwarra material.

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### References

- COOKSON, ISABEL C., and DETTMANN, MARY E., 1958. Some trilete spores from upper Mesozoic deposits in the eastern Australian region. *Proc. Roy. Soc. Vict.* 70 (2): 95-128.  
 DETTMANN, MARY E., 1959. Upper Mesozoic microfloras in well cores from Woodside and Hedley, Victoria. *Proc. Roy. Soc. Vict.* 71 (2): 99-105.  
 DOUGLAS, J. G., 1963. A Mesozoic dicotyledonous leaf from the Yangery No. 1 bore Koroit, Victoria. *Min. Geol. Jour.* 6: 5. (In press.)  
 MIKI, T. M., 1952. On the systematic position of *Hemitrapa* and some other fossil *Trapa*. *The Palaeobotanist* 1: 346-350.  
 ———, 1959. Evolution of *Trapa* from ancestral *Lythrum* through *Hemitrapa*. *Proc. Jap. Acad.* 35 (6): 289-294.  
 OLIVER, F. W., 1888. On the structure, development, and affinities of *Trapella*, Oliv., a new genus of Pedalineae. *Ann. Bot.* 2: 75-115.

### Explanation of Plates

#### PLATE III

- Fig. 1—Cf. *Hemitrapa* sp. Yangery No. 1 bore, 4320-30 ft, Reg. No. 58656, x 10. Specimens and fragments scattered on bedding plane.  
 Fig. 2—*Hemitrapa*? sp. Gemmill's Hill, Reg. No. 58229, x 10. Three specimens on uneven bedding plane.  
 Fig. 3—*Hemitrapa*? sp. Gemmill's Hill, Reg. No. 58226, x 11.  
 Fig. 4—*Hemitrapa*? sp. Gemmill's Hill, Reg. No. 58228, x 10.  
 Fig. 5—*Hemitrapa*? sp. Koonwarra, Reg. No. 58644, x 11.  
 Fig. 6—Cf. *Hemitrapa* sp. Yangery No. 1 bore, 4320-30 ft, Reg. No. 58657, x 11.  
 Fig. 7—Cf. *Hemitrapa* sp. Yangery No. 1 bore, 4320-30 ft, Reg. No. 58656, x 11. Counterpart of Reg. No. 58657 (Fig. 6).

#### PLATE IV

(Drawings by Miss M. Hall—Department of Mines, Victoria)

Dark patches represent areas of unflaked carbonaceous material. Compare with photographs (Plate III) as directed below.

- Fig. 1—Cf. *Hemitrapa* sp. Yangery No. 1 bore, 4320-30 ft, Reg. No. 58657, x 16. Cf. Pl. III, fig. 6.  
 Fig. 2—Cf. *Hemitrapa* sp. Yangery No. 1 bore, 4320-30 ft, Reg. No. 58656, x 16. Counterpart of Reg. No. 58657 (Fig. 1). Cf. Pl. III, fig. 7.  
 Fig. 3—*Hemitrapa*? sp. Gemmill's Hill, Reg. No. 58229, x 16. This specimen is smaller than average, and does not show strongly recurved appendages, but it among the best preserved. Cf. Pl. III, fig. 2, specimen at left, photographed prior to excavation.  
 Fig. 4—*Hemitrapa*? sp. Koonwarra, Reg. No. 58644, x 16. Cf. Pl. III, fig. 5.